

The Enlightenment

Prepare to Read

Objectives

In this section you will

1. Learn about approaches to science that began in the 1500s.
2. Identify discoveries of the Scientific Revolution.
3. Understand the ideas of the Enlightenment.
4. Find out how the Enlightenment affected governments.

Taking Notes

As you read this section, summarize how the Scientific Revolution and the Enlightenment affected governments at the time. Copy the chart below, and record your findings in it.

Scientists apply new ideas to the ways in which they understand the world.

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Target Reading Skill

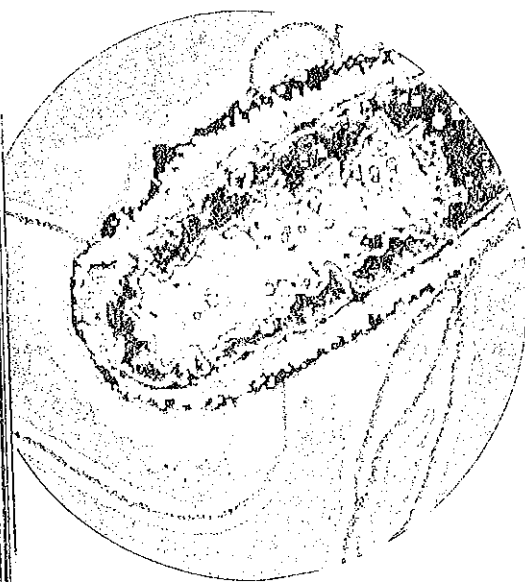
Use Context Clues You can sometimes figure out the meaning of an unfamiliar word from clues in context. For example, you can use a context clue to figure out the meaning of the word *royalty*:

People believed that kings and other royalty had the right to collect taxes.

The phrase *kings and other royalty* is a clue that royalty are people who are like kings. As you read, look for context clues for the word *microorganisms*.

Key Terms

- **scientific method** (sy un TIF ik METH ud) *n.* a way of performing experiments
- **natural laws** (NACH ur ul lawz) *n.* the patterns that control the behavior of the universe
- **Enlightenment** (en LYT un munt) *n.* the belief that science and natural laws bring individuals and society to a more enlightened state
- **natural rights** (NACH ur ul ryz) *n.* the rights to life, liberty, and property



Leeuwenhoek was the first person to study bacteria.

In Medieval times, scientists thought that living things, such as maggots, developed from nonliving things, such as rotten meat. The belief was called the theory of spontaneous generation.

In the 1600s, a Dutch merchant named Antoni van Leeuwenhoek (ahn TOH nee van LAY vun hook) constructed microscopes to examine the quality of his cloth. His microscope was more powerful than any previously used. Through his microscope, he saw what looked like tiny moving objects. In 1674, he concluded that these must be tiny animals. Leeuwenhoek's discovery showed that the small insects that ate spoiled grain and meat had hatched from tiny eggs laid by adult insects.

Leeuwenhoek's theories eventually led to our understanding of microorganisms such as germs and bacteria. Leeuwenhoek's work, like that of others during the Enlightenment, helped people see science as a way to improve the world.

Scientific Discoveries Encourage New Attitudes

As new ideas inspired by humanism and the Reformation spread across Europe in the 1500s and 1600s, scientists had begun applying new ideas to the ways in which they understood the world. They began to rely more on reason and logic than on superstition or old theories to explain the world.

One example of the use of reason was the development of the scientific method. Using the scientific method, a scientist conducts an experiment in steps, changing a single process or ingredient in each step. The scientist carefully observes and records what happens, and then uses these observations to explain the results. Experiments performed using the scientific method can be repeated by others. Discoveries made by the scientists of this period not only increased knowledge about the world but also changed the way that people lived.

Sometimes these experiments gave results that contradicted the teachings of the Roman Catholic Church in Europe. In the early 1600s, Galileo Gallilei (gal uh LAY oh gal uh LAY) used his observations to prove that the sun was the center of the universe and that the planets revolved around the sun. However, the official Catholic Church teaching at that time was that Earth was at the center of the universe and that the sun and planets revolved around Earth.

After Galileo published the results of his research in 1632, he was brought to Rome, where a court found him guilty of violating Catholic Church teachings. He was sentenced to life imprisonment, a sentence he served by remaining confined in his house in Florence for the rest of his life. Other scientists and writers were jailed for opposing the Catholic Church, and their writings were banned.

Despite these challenges, new ideas and methods continued to spread throughout Europe. These ideas and methods would change not only how Europeans thought about science, but also how they thought about religion, politics, and many other aspects of human nature and society.

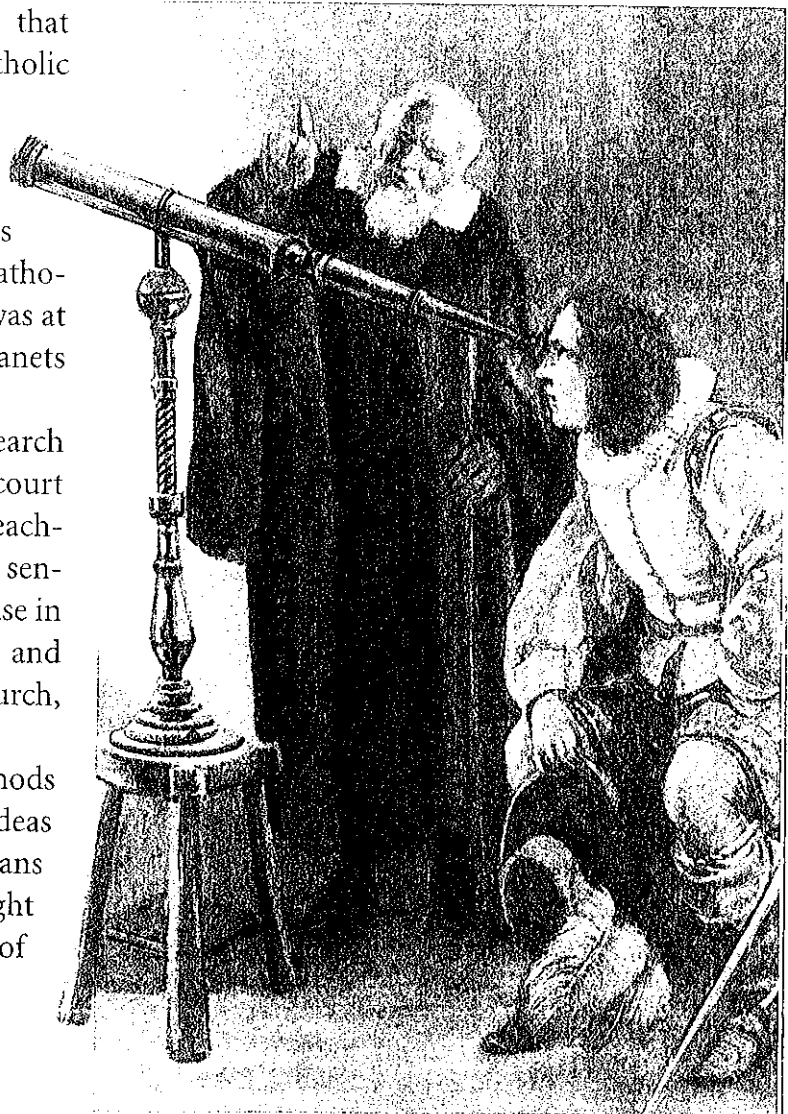
✓ Reading Check How did the Catholic Church react when scientific theories differed from Church teachings?

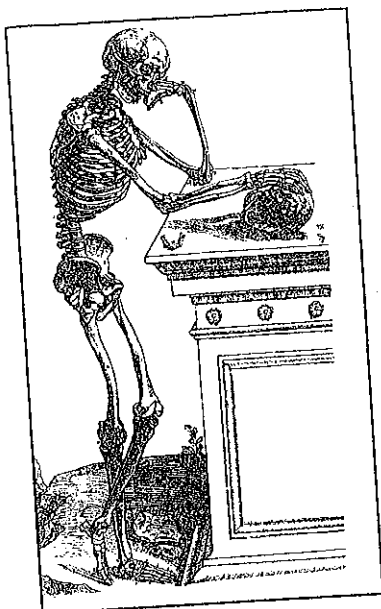
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Use Web Code
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on the scientific method.

Galileo and the Telescope

Galileo was the first person to use a telescope to study the stars and planets. *Inter* How might a telescope have helped Galileo to make new discoveries?





Revolutionizing Medicine

Vesalius demonstrated that accepted theories on the structure of the human body were not based on the study of human anatomy. He realized that previous physicians had merely applied information gathered from the structures of animals to that of the human body. Infer Vesalius's book (above) suggest about how he learned about the human body?

The Scientific Revolution

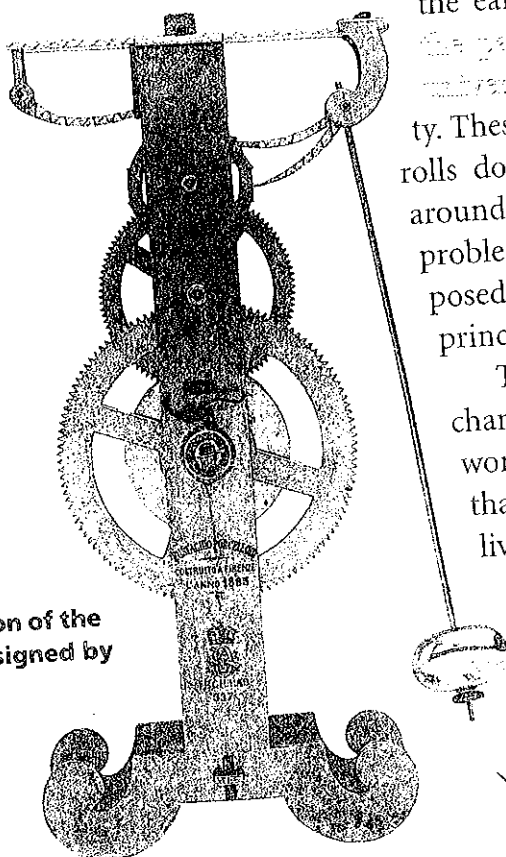
Galileo's work came during a period that historians now call the Scientific Revolution. From the mid-1500s through the mid-1700s, scientists made many significant discoveries in several different sciences. In 1543, Andreas Vesalius (AN dree us vih SAY lee us), a Flemish doctor, produced the first manual that used detailed pictures to show the structure of the human body. William Harvey, an English doctor, discovered that the human heart works like a pump and that blood is returned to the heart after it circulates through the body.

Beginning in 1637, the French philosopher René Descartes (ruh NAY day KAHRT) began to publish books proposing a system for geometry. He also used letters of the alphabet in math equations and analyzed how light was reflected from a mirror. His studies led to the development of analytic geometry. Descartes also proposed the idea that mathematics was the perfect model for reasoning in all of the sciences.

Robert Boyle, an Irish chemist, disproved the centuries-old idea that all matter was made of a combination of four things: air, water, earth, and fire. Boyle argued in the late 1600s that matter was made up of a more complex combination of chemicals. Boyle's work became the foundation of modern chemistry.

In the mid-1700s, the British scientist Sir Isaac Newton studied the motion of the planets and objects on the earth. His theories about ~~gravity~~ *the forces that control the behavior of the universe*, included the laws of motion and gravity. These laws explain everything from why a rock rolls down a hill to the way the Earth revolves around the sun. His studies helped explain some problems with the theories that Galileo had proposed a century earlier, but still upheld their basic principles.

These scientific discoveries and many others changed the way that people understood the world around them. People began to believe that science and reason could improve their lives. Although some of the explanations were later proven wrong, the dedication of these scientists to the scientific method and their belief in the use of reason continue to be the basis for science today.



An 1883 reproduction of the pendulum clock designed by Galileo

✓ Reading Check How did William Harvey help increase scientific knowledge?

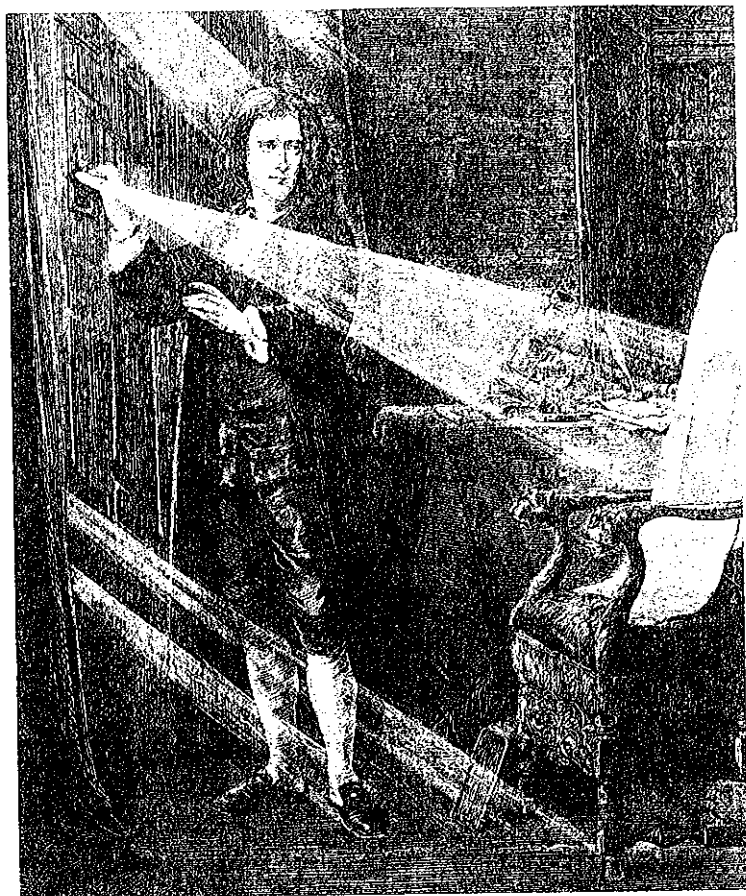
New Ways of Thinking

In 1687, Newton published his ideas in a book called *Mathematical Principles of Natural Philosophy*. As scientists and thinkers across Europe understood Newton's work, they believed his approach could discover other natural laws. Their belief in the power of science and reason inspired them. They began to search for natural laws in human behavior as well.

To help them keep up with the pace of new discoveries, scientists began forming organizations through which they could share new knowledge and exchange ideas. The first of these organizations was created in Italy in the early 1600s. Two of the most important were formed in the mid-1660s: the Royal Society of London for the Promotion of Natural Knowledge and the Académie des Sciences (a ka day MEE day see AHNS) of Paris. These societies published papers explaining new discoveries in a way that could be understood by all scientists. Through these and other organizations like them, scientific knowledge spread rapidly throughout Germany, England, Italy, Russia, the Netherlands, and the American colonies.

This movement across Europe became known as the Enlightenment because of the belief that science and natural laws of behavior would bring individuals and society to a better, or more enlightened, state. It is sometimes called the Age of Reason because people believed they could understand the world with their intelligence. This way of thinking affected politics, art, literature, science, and religion.

✓ Reading Check How were Enlightenment ideas communicated throughout Europe?



Newton concluded that a prism separates light into the colors of the spectrum because each color refracts, or bends, by a different amount.

The Enlightenment and the New Government

As Enlightenment ideas about science and reason spread, new theories about politics and government were developed. These new theories emphasized the rights of individuals and new ways that society could be organized.



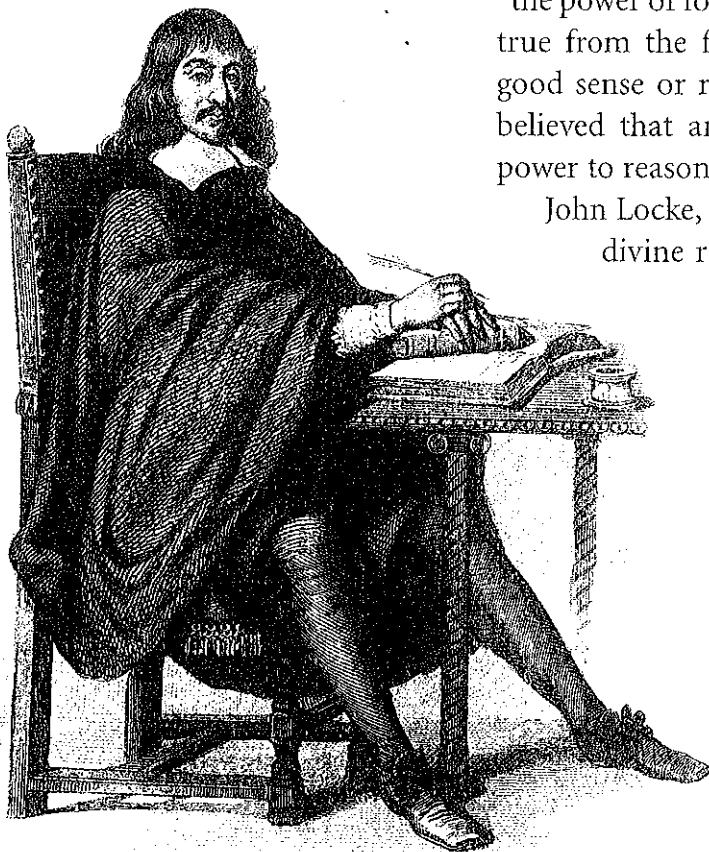
Use Context Clues

Sometimes the context will restate what a word means. Look for context clues to determine the meaning of *divine right*.

The Conflict Over Divine Right to Rule In Chapter 18, you learned that the monarchs who ruled in Europe were believed to have divine right. According to this theory, the right to rule had been decided by God, and rulers had to answer to God only. The people they ruled had no say in the government and no right to speak out against it. In 1651, the English writer Thomas Hobbes published a book that strongly supported the power of royalty and the divine right to rule. He believed that without a strong government to control them, people would behave badly and their lives would be “solitary, poor, nasty, brutish, and short.” He thought that people were naturally greedy and selfish and that they needed a king who could rule without any limits to preserve order.

Many Enlightenment thinkers disagreed with Hobbes’ view of human nature. According to the French philosopher Descartes, “the power of forming a good judgment and of distinguishing the true from the false, which is properly speaking what is called good sense or reason, is by nature equal in all men.” Descartes believed that any person who had a good education had the power to reason and make good decisions.

John Locke, an English writer, also opposed the theory of the divine right of kings. In his 1690 book, *Two Treatises of Government*, Locke applied Enlightenment ideas to government and challenged the divine right of kings. He argued that all people possessed certain *natural rights* when they were born, including *the right to life, liberty, and property*. He also argued that the people should hold the power of government. According to his theory, a government should rule only if it followed natural laws and protected people’s natural rights. Locke argued that the people should overthrow a government that does not do these things.



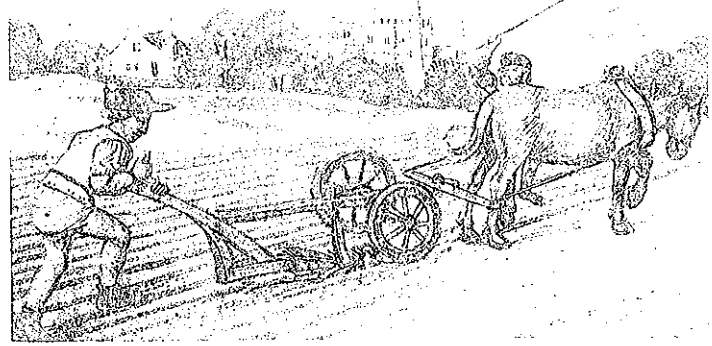
René Descartes

Enlightened Rulers Among the upper classes in Europe, the ideas of the Enlightenment became very popular. Even kings and queens became familiar with them.

Frederick the Great of Prussia ruled over much of what is now Germany and Poland from 1740 to 1786. He made changes within his country that reflected Enlightenment ideas. He retained absolute power, but he believed he should work for the common good. He helped peasant farmers and made laws so that they were fairer to all classes of people.

Catherine the Great of Russia (1762–1796) expanded the Russian educational and public health system. However, even as she made these changes, she also expanded landowners' authority over peasants.

Joseph II of Austria (1765–1790) allowed religious tolerance and limited the power of the Catholic Church to take action in his kingdom. He reformed laws, established independent judges, freed the serfs, and allowed the publication of ideas that were opposed to his or to those of the church. However, many people in the upper class in his country opposed such big changes.



Even though some monarchs started reforms during the Enlightenment, serfdom continued in Europe until the 1800s.

✓ **Reading Check** How did Enlightenment thinking affect some of the rulers in Europe?



Section 1 Assessment

Key Terms

Review the Key Terms at the beginning of this section. Use each term in a sentence that explains its meaning.

Target Reading Skill

Find the word *promotion* on page 533. What do you think *promotion* means? What clues help you arrive at this meaning?

Comprehension and Critical Thinking

1. (a) **Define** What is the scientific method?
- (b) **Identify Cause and Effect** How did the scientific method change the practice of science?

2. (a) **List** List three areas of science affected by the Scientific Revolution.
- (b) **Summarize** How did the Scientific Revolution affect thinkers across Europe?
3. (a) **Identify** What was the Enlightenment?
- (b) **Identify Cause and Effect** How did Enlightenment ideas spread?
4. (a) **Explain** Explain how Enlightenment ideas helped some peasants and serfs in Europe.
- (b) **Compare and Contrast** Contrast the ideas of Hobbes and Locke on what rights people and governments should have.

Writing Activity

Write a journal entry that lists some scientific discoveries in medicine or other areas that have been made during your life or during the last 50 years. Describe how they have changed your life or other people's lives.

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